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Prediction of Attrition following Medical Problems in Basic Training¹

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Summary

Many military situations require performance under stress. Improved methods of predicting individual differences in the performance effects of stress can be valuable for training and assignment purposes. The present study employed recently developed measures of individual differences in stress reactivity to predict attrition following the development of medical problems in U.S. Navy recruit training.

Study participants were male U.S. Navy recruit volunteers ($n = 334$) who were transferred from regular training companies to a Medical Rehabilitation Program (MRP) for treatment during basic training. Transfer to MRP meant that the recruit had an acute illness or injury that was too severe to permit continued training with the regular company. Such problems make it more difficult to complete basic training and are demoralizing. Stress reactive individuals are believed to be unwilling to persist in striving for difficult goals, so it was predicted that they would be more likely to attrite from training after entering the MRP. Stress resistant individuals are very persistent and continue to strive in the face of difficulty, so it was predicted they would be more likely to succeed after entering MRP.

Stress reactivity status was determined from the pattern of scores obtained on the NEO Personality Inventory, a standardized, validated personality instrument. Based on prior work, scores on the five major dimensions measured by the inventory were combined to identify reactive individuals (neurotic, introverted, hostile, and unreliable; hereafter, SR+) and stress resistant individuals (emotionally stable, extraverted, agreeable, and conscientious; hereafter, SR-). The primary personality attributes of three additional groups included in the typology were hostile cynicism and introversion (A-), agreeableness and extraversion (A+), or conscientiousness (C+).

Initial analyses of the relationship between the typology and attrition determined from training records confirmed the stress reactivity model predicted that the A-, A+, and C+ groups would have comparable attrition. Further analyses combined these three types into a neutral stress response group (hereafter, SN) for comparison to the SR+ and SR- groups. SR+ recruits had a higher behavioral attrition (i.e., psychological and non-adaptability discharges) than SN recruits, but the two groups were comparable for non-behavioral attrition (i.e., medical and erroneous/fraudulent enlistment). SR- recruits had lower behavioral attrition relative to SN

recruits and tended to be less likely to attrite for nonbehavioral reasons. Overall, 84.7% of resistant recruits graduated after being transferred to the MRP compared to 25.6% of reactive recruits. In addition, the SR+/SN/SR- typology predicted attrition as well as discriminant function analysis using the five major personality measures as continuous dimensions.

These findings provide initial evidence that a simple stress reactivity typology comprised of SR+, SN, and SR- categories can accurately predict attrition. Further research is planned to replicate the findings and determine how well the findings generalize to other measures of performance in other stressful settings.

Introduction

Stress reactivity is a psychobiological construct deriving from work with children and nonhuman primates¹. Stress reactivity is defined by a set of overlapping behavioral and endocrine indicators (Higley & Suomi, 1989; Sapolsky, 1990a,b; Kagan, 1989; Kagan, Reznick, & Snidman, 1986). While behavioral indicators of stress reactivity in adult humans have not been precisely specified, there appears to be a consensus about the behavioral components of stress reactivity in the primate model. In a recent review summarizing observations relevant to that model, Higley and Suomi (1989) have described stress reactive animals as " . . . less likely to approach new stimuli, more anxious, more socially inhibited, and less likely to attempt challenging situations." The reactive animal also is described as being more acquiescent in social interactions and more likely to show depressive symptomatology when separated from other animals or surrogates it was reared with. Sapolsky (1990a,b) provides a complementary description of a low reactivity animal as one who can correctly discriminate between threatening and non-threatening situations, who initiates direct aggression when threatened, provided he can win, or who displaces aggression if he loses a fight. The present paper presents the results of a study that tested the hypothesis that stress reactivity differences will predict attrition in U.S. Navy recruits who encounter a significant health problem while going through basic training.

The hypothesis that stress reactivity is related to attrition from basic training was tested using a provisional stress reactivity measurement model developed by Vickers (1991). The measurement model was developed by applying cluster analytic procedures to NEO Personality Inventory (Costa & McCrae, 1985) measures of the five-factor model of personality to determine whether a typology for young adult male humans could be developed for the purpose of testing hypotheses pertaining to stress reactivity. The cluster analyses indicated that it was reasonable to assume that the population studied included between 3 and 5 distinct types. Two of the types identified in these analyses corresponded well enough to a priori predictions regarding the personality profiles of reactive and resistant individuals to justify an initial claim that these groups represented the types previously identified in studies of stress reactivity and behavioral inhibition. In this typology, stress reactive individuals (hereafter, SR+) were high on neuroticism and low on conscientiousness, extraversion, and agreeableness. The reverse pattern described the stress resistant group (hereafter, SR-) and, in addition, there was a tendency toward higher

openness in this group. The remaining three groups had intermediate profiles marked by moderate deviations from the sample mean on just one or two of the five dimensions. Although prior work has assumed that stress reactivity involves only three types, the five-group typology was adopted as a provisional representation for stress reactivity, partly because it provided the opportunity to invalidate the reactivity model by showing that differences between the other groups are important predictors of behavioral differences.

Attrition is an important real-life criterion which is likely to be correlated with reactivity status. Given the SR+ and SR- profiles, the prediction that stress reactive individuals will have higher attrition rates than stress resistant individuals is trivial. Extensive reviews of personality and job performance link low conscientiousness, high neuroticism and low extraversion to poor performance and organizational turnover (Kamp & Hough, 1988; Barrick & Mount, 1991). For this reason, the present report emphasizes two more specific issues pertaining to the stress reactivity typology rather than the general question of whether the typology is related to attrition.

One focal issue is attrition as a criterion for evaluating alternative structures for the reactivity typology. Observational studies of children and nonhuman primates have led to a three-group classification comprised of groups which can be labelled stress reactive (or "inhibited," cf., Kagan, 1989) and stress resistant (or "nonreactive," cf., Higley & Suomi, 1989; Sapolsky, 1990a,b). The third group, which is believed to comprise the majority of the population, is not given a specific label, but can be considered neutral in the sense that these individuals are neither reactive nor resistant. In contrast, Vickers' (1991) typology includes five types, two of which had personality profiles that corresponded reasonably well to a priori hypotheses about the structure of personality for reactive and resistant individuals. The three additional groups in the typology had average personality profiles that were less extreme than those of the reactive and resistant groups in terms of overall deviation from the profile defined by the sample means. In these groups, the key personality variables were lower than average scores on Agreeableness and Extraversion in one group, higher than average scores on these two dimensions in another group, and a higher than average score on conscientiousness in the remaining group. These groups will be referred to as "A-," "A+," and "C+," respectively, below.

The three additional groups in Vickers' (1991) typology were reliably identified in cluster analyses and were retained as part of a provisional typology to ensure that subsequent analyses,

such as those reported here, had the potential to invalidate the stress reactivity typology. The three-group formulation of stress reactivity implies that these additional groups should be behaviorally equivalent under stress. Any demonstration of significant differences between these theoretically homogenous groups would imply that a more complex representation of individual differences was required. While more complex or detailed representations of individual differences almost certainly are the most appropriate level of analysis for at least some types of behavioral criteria, attrition provides a very general assessment of behavioral adaptation. Individuals can fail to adapt to social situations for a variety of reasons and can manifest that failure in many different behavioral patterns. By analogy to findings based on models which describe individual differences in terms of continuous dimensions, it can be argued that a general behavioral outcome such as attrition will be predicted best by personality models formulated at correspondingly general levels (Anastasi, 1985; Gorsuch, 1991). One objective of this study was to test the hypothesis that the three additional groups in Vickers' (1991) typology (hereafter referred to collectively as the neutral groups and designated "SN" for "stress neutral") did not differ with respect to this general measure of adaptation to the stress of a novel social setting.

The second focal issue for this study was how well the stress reactivity typology performed in predicting attrition relative to predictions based on the more common procedure of treating personality differences as occurring along continuous dimensions. The typology approach groups people into classes with the implicit assumption that individuals within each class are equivalent. Differences within groups are assumed to be either unimportant for predicting behavior (Gangestad & Snyder, 1985) or as having different functional relationships to behavior in different groups (Mendelsohn, Weiss, & Feimer, 1982; Hicks, 1984). The typology approach and the continuous dimension approach are not incompatible conceptually (Gangestad & Snyder, 1991), but it is important to determine whether the stress reactivity typology has something to add to the usual treatment of personality.

One key issue in comparing typological and dimensional personality models is that typologies reduce graded differences in personality to a few categorical distinctions. In the present case, the personality inventory used can produce more than 10^{11} different score combinations. The typology reduces these possibilities to 5 groups with the attendant possibility that useful predictive information has been discarded. A second study objective, therefore, was

to compare the predictive utility of typological and dimensional approaches to personality.

The research objectives were addressed in a study of U.S. Navy male recruits undergoing basic training. Basic training is an ideal situation for extending prior research on stress reactivity to adult humans because basic training involves a transition from previous living situations that has been repeatedly described as presenting significant adaptive challenges (Maskin & Altman, 1943; Janis, 1945; Bourne, 1967; Zurcher, 1968). In this regard, basic training is similar to the situation in which an adolescent chimpanzee makes the transition from his birth troop to a new troop, a time when the differences in reactivity affect adaptation in these nonhuman primates (Higley & Suomi, 1989). Thus, basic training provides a human analog to conditions known to elicit stress reactivity patterns in nonhuman primates. The types of social challenges presented by this situation are qualitatively similar to the social factors believed to be among the primary activators of stress reactivity behavioral patterns (Higley & Suomi, 1989; Sapolsky, 1990a,b).

The recruits participating in this study all encountered medical problems during basic training that were treatable, but serious enough to require transfer from regular training companies to a special medical program (Bischoff, 1991). This point is important from the present perspective, because the medical problem represented a significant impediment to the recruit's progress toward his presumed goal of completing training. Such problems are demoralizing (Farkas, 1980; Vickers, Gordon, Donaldson, Hervig, & Bischoff, 1991) and lead to excess attrition relative to the general recruit population (Hervig, Vickers, & Bischoff, 1991). The medical problems were fortuitous for evaluating the stress reactivity construct. These medical problems define a group of recruits who met exceptional challenges to goal attainment in the sense that they were removed from their training company and lost time in progressing through the training program. The implied standardized challenge to goal attainment is important, because the tendency to avoid or give up on difficult goals is one factor that distinguishes reactive and resistant individuals (Higley & Suomi, 1989).

Method

Sample

Study participants were male U.S. Navy recruits ($n = 334$) who volunteered to participate in a study of psychological factors affecting recovery from illness. The typical participant was

20.4 (S.D. = 2.9, range = 17-35) years of age with 12 (68%) or more (11%) years of education. Most participants indicated White as ethnic background (71%); Black Americans (18%) and Hispanic Americans (7%) comprised the primary minority groups.

Personality Measures

The NEO Five-Factor Inventory (NEO-FFI; Costa & McCrae, 1989) provided measures of Neuroticism, Extraversion, Openness to Experience, Agreeableness, and Conscientiousness. The NEO-FFI provides reliable assessments of these major dimensions and the measures have good discriminant and convergent validity when peer ratings are used as the comparison criterion (Costa & McCrae, 1989; Costa & McCrae, 1987). Responses were made using a 5-point Likert scale ranging from "strongly disagree" to "strongly agree". The specific measures were:

- a) Neuroticism assessed adjustment vs. emotional instability and identifies individuals prone to psychological distress, unrealistic ideas, excessive cravings or urges and maladaptive coping responses. (12 items; Cronbach's alpha = .86)
- b) Extraversion assessed quantity and intensity of interpersonal interaction, activity level, need for stimulation and capacity for joy. (12 items; Cronbach's alpha = .82)
- c) Openness assessed proactive seeking and appreciation of experience for its own sake; toleration for and exploration of the unfamiliar. (12 items; Cronbach's alpha = .61)
- d) Agreeableness assessed the quality of one's interpersonal orientation along a continuum from compassion to antagonism in thoughts, feelings and actions. (12 items; Cronbach's alpha = .76)
- e) Conscientiousness assessed the individual's degree of organization, persistence and motivation in goal-directed behavior; extreme scores contrast dependable, fastidious people with those who are lackadaisical and sloppy. (12 items; Cronbach's alpha = .88)

The original stress reactivity classification procedures were developed using scores on the NEO Personality Inventory (NEO-PI; Costa & McCrae, 1985) rather than the NEO-FFI. The NEO-PI consists of the 60 NEO-FFI items plus 120 items. Development of linear classification functions to define group membership based on NEO-FFI scores was the first step in the present

study. This development was accomplished by discriminant analysis with the NEO-FFI scores as the predictor variables. The five-group classification produced by the partitioning cluster analyses described in Vickers (1991) was the group classification variable.

Group membership assignments determined from the NEO-FFI linear classification functions were compared to similar assignments determined from the NEO-PI linear classification functions derived using the same discriminant procedure to evaluate convergence of the long- and short-form classifications. The NEO-FFI classification matched the NEO-PI classification for 79.6% (2303 of 2892) of the cases. One reason for the differences in prediction was that the NEO-FFI classifications classified a larger percentage of the cases into the reactive and resistant groups than did the NEO-PI. This point is evident from a consideration of the sensitivity and specificity of the NEO-FFI classifications. Sensitivity is the probability that a true instance of a reactive or resistant individual will be correctly classified using the FFI. With regard to the most theoretically important groups, using the NEO-PI classification as the reference criterion for determining true group membership, the NEO-FFI had a sensitivity of 93.9% (388 of 413) for the reactive group and 91.0% (405 of 445) for the resistant group. Specificity is the probability that an individual who is classified into a particular group based on the FFI is truly a member of that group using the classification for the NEO-PI as the reference criterion. Specificity was 76.8% (388 of 505) for the reactive group and 84.9% (405 of 477) for the resistant group. Thus, better than 9 of 10 reactive and resistant individuals are correctly identified by the NEO-FFI, but this accuracy is achieved in part by expanding the classification groups to include 15% to 25% nonreactive/nonresistant individuals. No reactives were classified as resistant or vice versa, so the classification based on the NEO-FFI produced groups that were amalgamations of one extreme group and some recruits from the three theoretically neutral groups. Some apparent misclassifications no doubt are the product of error in the NEO-PI reference criterion because this criterion is empirically derived and no doubt includes some misclassifications which make it a less than perfectly accurate criterion. Thus, the results provided reasonably accurate overall identification of different categories within the proposed typology.

Attrition Data

Information about the reason for attrition from basic training was gathered from records

maintained by the Recruit Training Command and coded into five categories. "Graduates" successfully completed basic training. "Medical Discharges" were recruits discharged from the service prior to completing basic training because of pre-existing physical health problems or injury or illness during basic training. "Psychological Discharges" were recruits given medical discharges on the basis of acute or chronic psychological disturbances as determined by clinical psychologists at the Mental Health Unit of the Recruit Training Command. "Fraudulent/erroneous Discharges" were recruits who were discharged because of legal or behavioral problems that occurred prior to entering the service. The discharge was fraudulent if the recruit failed to disclose these problems prior to enlisting and erroneous if the recruit disclosed the problem and enlisted in the belief that the requirement would be waived in his case but it was not. "Non-adaptability Discharges" were recruits whose behavior and performance in training suggested that they could not adjust to basic training well-enough to perform adequately.

Some analyses employed all five attrition categories defined above. However, these initial classifications were not well-suited to testing some hypotheses about behavioral adaptation under stress. If differences in stress reactivity status are related to attrition by processes that involve psychological and behavioral adaptation to the adjustment demands of basic training, increased attrition in the stress reactive group might be localized in certain categories of attrition. Non-adaptability implies that the recruit is doing poorly in adjusting to training. Similarly, psychological attrition is based on diagnoses which imply adjustment problems, although in this case it is not certain whether these problems are a response to the situational demands. There is evidence that stress reactivity is related to psychiatric diagnoses (Biederman et al., 1990) and the situation may be an activator or accentuator of these behavioral problems. Both non-adaptability attrition and psychological attrition, therefore, can be reasonably expected to be related to stress reactivity status.

Other types of attrition are less clearly linked to stress reactivity status. Considering medical attrition, some recruits are likely to develop problems that are not related in any way to their psychological adjustment to the situation. When a recruit does become ill or is injured, the symptomatic manifestations of the underlying medical problem may be accentuated in stress reactive individuals (Costa & McCrae, 1987). This accentuation could influence decisions regarding whether or not to discharge a recruit, but even in these cases some real evidence of

illness or injury would be required. Stress reactivity status therefore could affect the probability of attrition for medical reasons, but it is likely that the bulk of this attrition does not depend on adaptive responses deriving from reactivity differences.

Erroneous/fraudulent attrition represents a similarly ambiguous criterion with regard to stress reactivity. The behaviors that give rise to this type of attrition take place before entry into training. This temporal ordering precludes regarding this type of attrition as evidence of poor adaptation to the demands of training. Erroneous/fraudulent enlistment attrition still could be a product of reactivity differences if those differences are related to social adjustment in general. However, it is possible to make a case that the relationship between reactivity status and poor social adjustment prior to entry into the service would depend on the social environment. Comparable expression of the behavior patterns underlying stress resistance, for example, might lead to being a high school student body president or a gang leader. For this reason, it did not seem reasonable to expect a simple relationship between reactivity status and erroneous/fraudulent attrition.

The preceding considerations led to a series of analyses which used a 3-group classification which combined psychological and non-adaptive discharges into a general "adaptation attrition" category and medical and erroneous/fraudulent discharges into an "other attrition" category. A final attrition criterion was constructed by combining all types of attrition into a single category. This criterion paralleled the common practice of simply comparing graduating recruits with those discharged prior to completing basic training. In presenting the results, the variables produced by these three levels of aggregation of discharged codes are referred to as Specific Attrition, Adaptational Attrition, and General Attrition, respectively.

Analysis Procedures

Cross-classification analyses were performed with the SPSS-X routine "CROSSTABS." Follow-up analyses compared the reactive and resistant groups to the neutral groups to determine where these two groups differed from the neutral groups. In these follow-up analyses, the expected number of reactive or resistant recruits meeting a particular fate in training was computed by multiplying the total number of reactive or resistant recruits by the proportion of neutral recruits meeting the fate of interest. The resulting value was used as the expected number of reactive or resistant recruits for the purpose of computing a chi-square value using the

following formula:

$$\text{Chi-square} = \frac{(\text{Observed} - \text{Expected})^2}{\text{Expected}}$$

The SPSS-X routine "DISCRIMINANT" was used to determine the relationship between the five personality dimensions, considered as continuous measures, and attrition. In this analysis, the prior probability of a recruit meeting a particular fate in training was based on the observed proportion of recruits meeting that fate by employing the subcommand "Priors = Size." All statistical procedures were performed with the SPSS-X (SPSS, Inc., 1988).

Results

Neutral Types and Attrition. One study objective was to determine whether the three neutral groups (A-, A+, and C+) differed with respect to attrition. Analyses based on the pertinent cells of Table 1 indicated that the attrition rates for these groups did not differ significantly whether the criterion was Specific Attrition (chi-square = 4.74, 8 df, $p > .78$), Adaptational Attrition (chi-square = 2.72, 4 df, $p > .60$), or General Attrition (chi-square = 2.67, 2 df, $p > .26$). Based on these findings, subsequent analyses employed a three-group typology combining the A-, A+, and C+ groups into an overall neutral group.

Table 1
Reactivity Typology and Attrition

	Personality Type:		
	Stress Reactive (n = 39)	Stress Neutral (n = 158)	Stress Resistant (n = 137)
Psychological Attrite	33.3%	7.6%	2.9%
Non-Adaptability Attrite	23.1%	6.3%	2.2%
Medical Attrite	12.8%	15.2%	7.3%
Fraud/Legal Attrite	5.1%	1.9%	2.9%
Graduate	25.6%	69.0%	84.7%

Reactivity Typology and Attrition. The 3-group stress reactivity typology was significantly related to attrition (Table 1) whether the criterion was Specific Attrition (chi-square = 73.22, 8 df, $p < .0001$), Adaptational Attrition (chi-square = 70.60, 4 df, $p < .0001$), or General Attrition (chi-square = 50.99, 2 df, $p < .0001$).

Attrition Among Reactives. Considering Table 1 in more detail, the prediction that reactive individuals would have above average attrition rates was confirmed. Only 25.6% of the reactive individuals graduated compared to 69.0% for the neutral group (chi-square = 10.63, 1 df, $p < .001$). The excess attrition for the reactive type was due to the combination of psychological and non-adaptability attrition (56.4% of reactivities versus 13.9% of neutrals; chi-square = 50.70, 1 df, $p < .0001$) as there was virtually no difference between reactivities and neutrals for non-behavioral attrition (17.9% versus 17.1%; chi-square = .02, 1 df, $p > .887$). The excess adaptational attrition was evident for both Psychological Attrition (33.3% versus 7.6% for neutrals; chi-square = 33.98, 1 df, $p < .0001$) and Non-Adaptability Attrition (23.1% versus 6.3% for neutrals; chi-square = 17.42, 1 df, $p < .0001$).

Attrition Among Resistant Recruits. The graduation rate in the resistant group (84.7%) was significantly higher than that in the neutral group (chi-square = 4.88, 1 df, $p < .01$). Overall, the resistant group was less likely than the neutral group to attrite for adaptational problems (5.1% versus 13.9%; chi-square = 7.62, 1 df, $p < .0001$). There was a trend toward a lower rate of "other" attrition for the resistant group than for the neutral groups (10.2% versus 17.1%; chi-square = 3.79, $p < .052$). This trend was the product of a lower rate of medical attrition in the stress resistant group (7.3% versus 15.2%; chi-square = 11.72, 1 df, $p < .001$).

Personality Dimensions and Attrition. Personality differences between groups were consistent with expectations based on prior research (Table 2). Thus, attrites scored higher on Neuroticism, and lower on Extraversion, Openness, Agreeableness, and Conscientiousness. The scores for the Nonbehavioral Attrite group were consistently intermediate between the extremes provided by the scores for the Graduates and the Behavioral Attrites.

Table 2
Group Differences in Personality

		Behavioral Attrite	Nonbehavioral Attrite	Graduate	F	Sig.
Neuroticism	Mean	2.58	2.15	1.69	35.27	.0001
	S.D.	.71	.73	.73		
Extraversion	Mean	1.92	2.28	2.48	22.35	.0001
	S.D.	.69	.60	.51		
Openness	Mean	2.10	2.17	2.26	2.36	.0960
	S.D.	.51	.44	.48		
Agreeableness	Mean	2.34	2.51	2.62	6.61	.0015
	S.D.	.63	.49	.49		
Conscientiousness	Mean	2.34	2.68	2.96	28.49	.0001
	S.D.	.68	.56	.51		

Personality predicted attrition with moderate precision in the discriminant analysis. Overall, predictions based on the discriminant functions correctly classified 252 recruits (75.4%) who either were predicted to graduate and did or were predicted to attrite and did (Table 3). A comparable figure for the typological prediction can be derived by predicting that resistant and neutral recruits will graduate from training and reactive recruits will attrite from training. This total would be 254 correct predictions based on 116 graduating resistant recruits, 109 graduating neutral recruits, and 29 attriting reactive recruits.

If attention were restricted to the accuracy of prediction of attrition, the specificity of the discriminant function approach would be 77.4%, i.e., 24 of the 31 recruits who were predicted to attrite actually did attrite. The sensitivity of the discriminant function approach would be 24.2% based on correct identification of 24 of the 99 recruits who attrited. The comparable figures for the typology would be a specificity of 74.4% based on attrition of 29 of 39 reactive recruits and a sensitivity of 29.3% based on correct prediction of outcome for 29 of 99 attrites.

Table 3
Prediction of Attrition based on Discriminant Function Analysis

<u>Actual Outcome</u>	<u>Predicted Outcome:</u>		
	Behavioral Attrite	Nonbehavioral Attrite	Graduate
Adaptational Attrite (n = 51)	61.3%	0.0%	10.6%
Other Attrite (n = 48)	16.1%	0.0%	14.2%
Graduate (n = 235)	22.6%	0.0%	75.2%
Column n =	31	0	303

NOTE: Percentages are based on column totals to correspond to the percentages in Table 1.

The preceding comparison of alternative predictive models is influenced by two choices. First, the choice of Adaptational Attrition as the criterion had an effect. With Specific Attrition as the criterion, the discriminant function predictions were correct only 46.4% (155 correct) of the time. With General Attrition as the criterion, the discriminant function predictions were correct 71.3% (238 correct) of the time. Thus, the choice of Adaptational Attrition as the reference criterion produced the optimum predictive accuracy for the discriminant function analyses.

The second choice which affected the comparison of the alternative predictive models was the specification of the rules determining what constituted a correct prediction. In the initial comparison above, the predictive rule basically treated behavioral and nonbehavioral attrition as equivalent. In other words, a recruit who was predicted to be a behavioral attrite, but actually was discharged for medical reasons, or vice versa, was scored as a correct prediction for both models. More restrictive predictive rules could have been applied. In the case of the stress reactivity typology, the specific prediction could have been made that stress reactive individuals would attrite for behavioral reasons and all other recruits would graduate, the stress reactivity model would have been correct 74.0% (247 correct) of the time.

Discussion

The study findings provided reasonably clear-cut conclusions regarding both focal issues addressed in this study. The first issue was whether the three theoretically neutral types in Vickers' (1991) provisional representation of the stress reactivity typology were comparable with respect to attrition from training. The evidence clearly supported the position that these groups were comparable, a result which implies that the tripartite stress reactivity typology emphasized by Kagan (1989) applies to young adult adolescent human males. If similar results obtain when other stress reactivity criteria are examined, the tripartite typology can be adopted to represent individual differences in stress reactivity.

The second focal issue was whether the use of a typology would result in loss of predictive power relative to a continuous dimensions model of personality. There was no such loss as the attrition predictions were accurate 76.0% of the time for the typology compared to 75.4% of the time for the discriminant functions². Even with a more stringent prediction that stress reactives would attrite specifically because of poor adjustment to basic training, the stress reactivity model would produce correct predictions 74.0% of the time. In addition, the prediction that reactive recruits would attrite was correct 74.4% of the time (29 of 39) compared to a correct prediction rate of 77.4% of the time (24 of 31) for recruits predicted to attrite based on the discriminant functions. If the five-factor dimensional model is accepted as a plausible competing alternative to the reactivity typology³, the comparison indicates that the two models provide comparable predictive accuracy in this data.

Given these findings, the stress reactivity typology is preferable to the continuous dimensions model for the purpose of predicting one important indicator of real life adjustment processes. The typology predictions were based on a priori group specification in contrast to the a posteriori predictions from the continuous dimensions model. The latter predictions had the opportunity to capitalize on chance to optimize predictive accuracy. Shrinkage in predictive accuracy is to be expected if this predictive model based on continuous dimensions were applied to other samples. The reactivity typology, therefore, is likely to provide more robust predictions of attrition when applied to new samples.

It might be argued that the model comparisons were biased because the typology involved a higher level of aggregation than the discriminant functions. This point might be raised on the

grounds that the predictions for the typology reduced scores on five personality dimensions to a single three-category classification while the discriminant analysis employed five distinct dimensions. If true, this argument would lead to the prediction that the typology actually should perform better than the discriminant functions, because aggregation generally enhances the predictive accuracy of personality measures (e.g., Epstein, 1979; Kenrick & Funder, 1988). However, the two sets of predictions do not differ with respect to level of aggregation. Both typology classifications and the discriminant function predictions are based on linear classification functions which are composites of the five basic personality dimensions. Thus, both sets of predictions involve comparable levels of aggregation of the personality measures. Since both sets of predictions employed the same criterion variables, the level of aggregation is comparable with respect to both the predictors and criterion in both analyses. The crucial difference between the two sets of predictions, therefore, is that the typology represents an independently derived classification while the discriminant classification is designed to optimize prediction within the sample. Overall, then, the stress reactivity typology was as effective as the optimal predictive model feasible with the dimensional approach to individual differences and carries with it the advantage of a priori specification.

One important finding was that attrition differences between stress resistant, stress neutral, and stress reactive recruits were most pronounced for behavioral attrition. The category of behavioral attrition was contrasted with non-behavioral attrition in the analyses because the conceptual basis for stress reactivity implies problems adjusting to the demands of novel social situations. Psychological disturbances, poor performance, lack of motivation, and similar behavioral problems in basic training are implied by discharges falling in the behavioral category. If the stress reactivity model is correct, this type of attrition should differ between the three types, so the fact that this category showed more pronounced differences in attrition is important. It also was important that the differences were in the predicted direction with stress reactive recruits showing the highest rate of behavioral attrition and stress resistant recruits the lowest. The fact that both groups differed significantly from neutrals is reason to believe that all three types must be considered as distinct groups. Overall, this element of the findings provided the most important initial external validation of the stress reactivity model because it is not clear that differences would be expected for the non-behavioral components of attrition as this category was

defined here.

The results obtained for non-behavioral attrition also tended to support the stress reactivity model. The reasons for attrition falling in this category are not directly related to behavioral adaptation to the demands of training. It might be predicted, therefore, that these types of attrition would have little or no relationship to stress reactivity. For example, some past involvement with police or drug use cannot be regarded as being caused by exposure to basic training. At an overall level, data were consistent with the expected pattern as neither reactive nor resistant recruits differed significantly from neutral recruits. However, this finding must be qualified by the observation that the nonsignificant difference for stress resistant recruits was the result of combining a significantly lower rate of medical attrition in this group with a slightly higher rate of erroneous/fraudulent enlistment. A post hoc explanation for this trend would be that overcoming a medical problem is evidence of the willingness of stress resistant individuals to strive for difficult goals. Both stress neutrals and stress reactive individuals may have lacked the commitment and motivation to persist with the rehabilitation program and so on. This explanation is speculative as there is no direct evidence available pertaining to motivation during the program, but it does point to the fact that stronger tests of the model would be possible with more detailed analysis of the processes leading to attrition.

The stress reactivity typology can be applied effectively to predict adult male humans' success in adapting to at least one challenging situation. As such, the findings support Kagan's (1989) view that distinguishing three types of people provides a simple, powerful method of predicting important differences in behavioral reactions to stress. Further research to replicate these findings and extend the observations to other stress indicators such as mood, endocrine, and immune reactions to stress is needed. It also will be important to explore relationships between stress reactivity and other measures of individual differences in susceptibility to stress to determine whether this typology can provide an organizing framework for these constructs comparable to that which the five-factor model provides for personality measures in general. If the results replicate and generalize to other stress reaction indicators, the stress reactivity typology identified by Kagan (1989), Higley and Suomi (1989), Sapolsky (1990a,b) and their

colleagues can be used to draw together diverse strands in this complex field of inquiry and forge stronger bonds between these areas and the current developments in personality assessment and theory.

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Footnotes

¹"Stress reactivity" was chosen over "behavioral inhibition" as a label for the personality construct under investigation even though the two labels clearly apply to overlapping, possibly even identical, constructs. The choice of "stress reactivity" as the label in this study reflects a programmatic concern for identifying individual differences that affect responses to presumably stressful situations. Behavioral inhibition is an important component of the differences that define the overlapping biological and endocrine response patterns elicited by appropriate stimuli, but stress reactivity seemed to capture the specific focus on situationally-activated adaptive predispositions more effectively.

²It could be argued that an alternative analysis procedure such as logistic regression would be more appropriate for the purposes of maximizing prediction. However, the two approaches are closely related and logistic regression can be preferred largely on the basis that discriminant function weights tend to be biased away from zero when the predictor variables are not normally distributed (Hosmer & Lemeshow, 1989, pp. 34-36). In the present case, the predictor variables were reasonably normally distributed when considered at the univariate level. The Kolmogorov-Smirnoff subroutine in the SPSS-X NPAR TESTS program was applied to test the hypothesis that the personality scores were normally distributed. The z-score for the resulting tests was nonsignificant ($z < 1.34$, $p > .056$) for four of the five personality scales. The distribution for Agreeableness was significantly different from normal ($z = 1.46$; $p < .028$). However, if a Bonferroni adjustment (Dunn, 1958) were introduced to allow for the number of significance tests performed, even this value would be considered nonsignificant relative to the resulting $p < .01$ criterion. On the whole, the magnitude of bias due to nonnormality of the score distributions probably was modest provided that there was not substantial deviation from normality at the multivariate level for the score distributions.

³Some researchers might argue that the five-factor model is not a legitimate competing model for the stress reactivity typology. Such arguments could be justified on the grounds that the best dimensional approach to predicting attrition would be to select specific personality constructs rather than general dimensions as predictors. While there is some empirical support for this position (Mershon & Gorsuch, 1988), it is generally held that general dimensions will have the most value when predicting general criteria (e.g., Anastasi, 1985; Kenrick & Funder, 1988; Gorsuch, 1991). In the present instance, even relatively specific attrition categories are likely to represent relatively general criteria in the sense that many different specific behavioral patterns can lead to a similar outcome. If so, the five-factor model is an appropriate comparison basis for the reactivity typology.

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